

## AUTOMOTIVE CURRENT TRANSDUCERS OPEN LOOP TECHNOLOGY

HSNBV 100-(\*)X00; HSNBV 200-X00; HSNBV 300-X00; HSNBV 400-X00; HSNBV 500-X00; HSNBV 600-X00; HSNBV 700-X00; HSNBV 800-X00; HSNBV 900-X00;



### Introduction

The HSNBV series is for the electronic measurement of DC, AC or pulsed currents in high power and low voltage automotive applications with galvanic separation between the primary circuit (high power) and the secondary circuit (electronic circuit). The HSNBV series gives you the choice of having different current measuring ranges in the same housing.

### Features

- Ratiometric transducer
- Open Loop transducer using the Hall effect
- Low voltage application
- Unipolar +5 V DC power supply
- Maximum RMS primary admissible current: defined by busbar to have  $T < +150^{\circ}\text{C}$
- Operating temperature range:  $-40^{\circ}\text{C} < T < 125^{\circ}\text{C}$
- Output voltage: full ratio-metric (in sensitivity and offset).

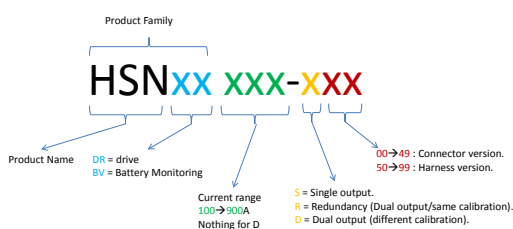
### Special feature

- (\*) Single (S) or dual channel sensor for wider measurement range (D) or redundancy (R).

### Advantages

- Excellent accuracy
- Very good linearity
- Very low thermal offset drift
- Very low thermal sensitivity drift
- Galvanic separation
- Non intrusive solution.

### Part numbering



N° 97.04.99.D02.0; N° 97.04.99.D03.0; N° 97.04.99.D04.0; N° 97.04.99.D05.0; N° 97.04.99.D06.0; N° 97.04.99.D07.0; N° 97.04.99.D08.0; N° 97.04.99.D09.0; N° 97.04.99.D10.0; N° 97.02.34.S00.0; N° 97.02.44.S00.0; N° 97.03.46.R00.0; N° 97.03.50.R00.0; N° 97.02.50.S00.0; N° 97.03.58.R00.0;

### Automotive application

- Battery Management
- EV, Hybrid and utility vehicles
- 48 V battery.

### Principle of HSNBV Family

The open loop transducers uses a Hall effect integrated circuit. The magnetic flux density  $B$ , contributing to the rise of the Hall voltage, is generated by the primary current  $I_p$  to be measured.

The current to be measured  $I_p$  is supplied by a current source i.e. battery or generator (Figure 1). Within the linear region of the hysteresis cycle,  $B$  is proportional to:

$$B(I_p) = a \times I_p$$

The Hall voltage is thus expressed by:

$$V_H = (c_H / d) \times I_H \times a \times I_p$$

Except for  $I_p$ , all terms of this equation are constant. Therefore:

$$V_H = b \times I_p$$

$a$  constant

$b$  constant

$c_H$  Hall coefficient

$d$  thickness of the Hall plate

$I_H$  current across the Hall plates

The measurement signal  $V_H$  amplified to supply the user output voltage or current.

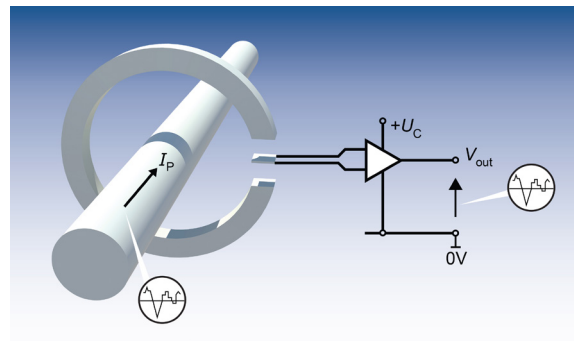
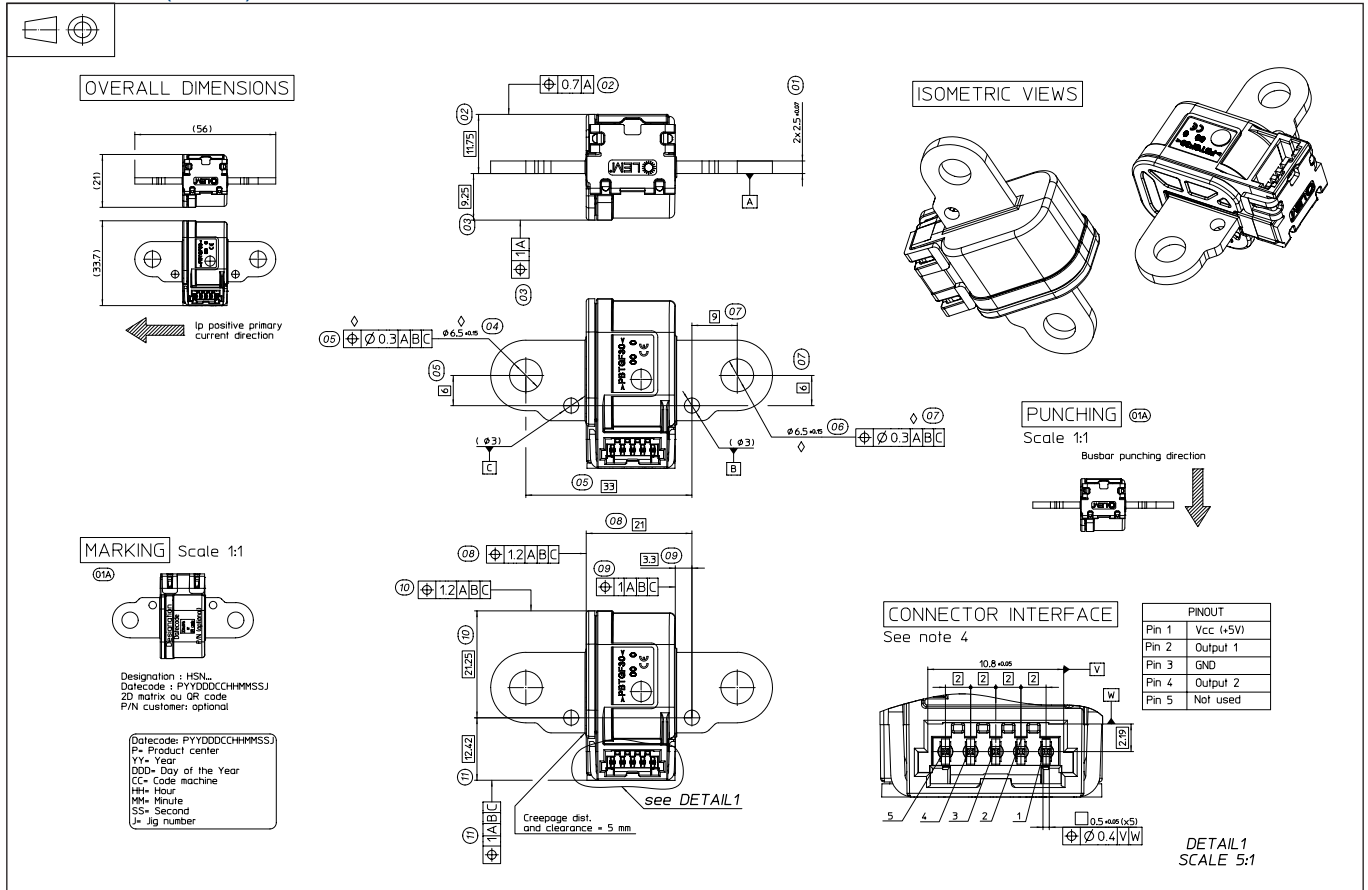


Fig. 1: Principle of the open loop transducer

**Dimensions (in mm)**

**Mechanical characteristics**

- Plastic case PBT GF30
- Magnetic core FeSi alloy
- Busbar Copper tin plated
- Mass 41 g  $\pm$  5 %
- Pins Brass tin plated
- IP level IP $\times$ 2

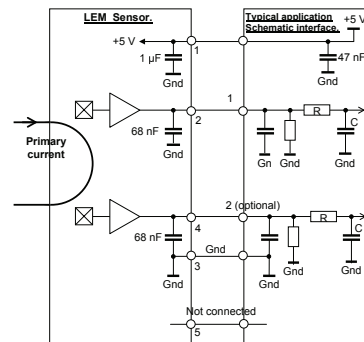
**Mounting recommendation**

- Mating connector: Molex Duraclik 5 pin:  
ISL version  
- Housing 5 pin black: 5601230501  
- Retainer 5 pin grey: 5601250500  
- Terminal tin plated: 5601240101
- Assembly torque: 7 N·m  $\pm$  10 %

Screw ISO M6 x 1 (class 6.8) mounted with flat washer and spring washer or flanged screw serrated are recommended.

**Remark**

- $V_{out} > V_o$  when  $I_p$  flows in the positive direction (see arrow on drawing).

**Electronic schematic**


$C_L < 100$  nF EMC protection (optional)  
RC Low pass filter (optional)

**On board diagnostic**

$R_L > 10$  K $\Omega$ . Resistor for signal line diagnostic (optional)

| $V_{out}$    | Diagnostic           |
|--------------|----------------------|
| Open circuit | $V_{IN} \leq 0.15$ V |
| Short GND    | $V_{IN} \leq 0.15$ V |

**Absolute ratings (not operating)**

| Parameter                                 | Symbol           | Unit              | Specification |         |      | Conditions                                 |
|-------------------------------------------|------------------|-------------------|---------------|---------|------|--------------------------------------------|
|                                           |                  |                   | Min           | Typical | Max  |                                            |
| Maximum supply voltage                    | $U_{C\max}$      | V                 | -14           |         | 14   |                                            |
| Insulation resistance                     | $R_{\text{INS}}$ | MΩ                | 500           |         |      | 500 V DC, ISO 16750-2                      |
| Maximum output voltage                    | $V_{\text{out}}$ | V                 | -14           |         | 14   | $V_{\text{out}}$ Reverse / Forward voltage |
| Maximum output current                    | $I_{\text{out}}$ | mA                | -10           |         | 10   | Continuous                                 |
| Ambient storage temperature               | $T_s$            | °C                | -40           |         | 125  |                                            |
| Electrostatic discharge voltage (HBM)     | $U_{\text{ESD}}$ | kV                |               |         | 8    | IEC 61000-4-2 / ISO 10605                  |
| Maximum admissible vibration (random RMS) | $\gamma$         | m·s <sup>-2</sup> |               |         | 94.8 | see profiles on page 12/13                 |
| RMS voltage for AC insulation test        | $U_d$            | kV                |               |         | 2.5  | 50 Hz, 1 min                               |
| Creepage distance                         | $d_{\text{Cp}}$  | mm                | 5.12          |         |      |                                            |
| Clearance                                 | $d_{\text{Cl}}$  | mm                | 5.12          |         |      |                                            |
| Comparative tracking index                | $CTI$            |                   | PLC0          |         |      | ≥ 600 V                                    |

**Operating common characteristics in nominal range ( $I_{PN}$ )**

| Parameter                                   | Symbol          | Unit  | Specification                                   |         |         | Conditions                                                                                            |
|---------------------------------------------|-----------------|-------|-------------------------------------------------|---------|---------|-------------------------------------------------------------------------------------------------------|
|                                             |                 |       | Min                                             | Typical | Max     |                                                                                                       |
| Electrical Data                             |                 |       |                                                 |         |         |                                                                                                       |
| Supply voltage                              | $U_C$           | V     | 4.75                                            | 5       | 5.25    |                                                                                                       |
| Ambient operating temperature               | $T_A$           | °C    | -40                                             |         | 125     |                                                                                                       |
| Output voltage                              | $V_{out}$       | V     | $V_{out} = (U_C/5) \times (V_o + G \times I_p)$ |         |         |                                                                                                       |
| Output resolution                           |                 | mV    |                                                 | 1.25    |         |                                                                                                       |
| Output clamping high voltage                | $V_{SZ}$        | V     | 4.70                                            | 4.75    | 4.80    | @ $U_C = 5\text{ V}$ , @ $-40\text{ °C} < T < 125\text{ °C}$                                          |
| Output clamping low voltage                 | $V_{SZ}$        | V     | 0.20                                            | 0.25    | 0.30    | @ $U_C = 5\text{ V}$ , @ $-40\text{ °C} < T < 125\text{ °C}$                                          |
| Current consumption                         | $I_C$           | mA    |                                                 | 7 (15)  |         | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$ (..) value for dual output.<br>9 (18) for 100 A version |
|                                             |                 |       |                                                 |         | 10 (20) | 12 (24) for version 100 A                                                                             |
| Load resistance                             | $R_L$           | KΩ    | 10                                              |         |         |                                                                                                       |
| Output internal resistance                  | $R_{out}$       | Ω     |                                                 | 1       | 10      | @ $T_A = 25\text{ °C}$                                                                                |
| Performance Data                            |                 |       |                                                 |         |         |                                                                                                       |
| Ratiometricity error                        | $\varepsilon_r$ | %     |                                                 | ±0.3    |         | @ $T_A = 25\text{ °C}$                                                                                |
| Sensitivity error                           | $\varepsilon_G$ | %     |                                                 | ±1      |         | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$                                                         |
| Electrical offset voltage                   | $V_{OE}$        | mV    |                                                 | ±4.0    |         | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$ (±8 mV for $I_{PM} \leq 100\text{ A}$ )                 |
| Magnetic offset voltage                     | $V_{OM}$        | mV    |                                                 | ±3      |         | @ $U_C = 5\text{ V}$ , @ $T_A = 25\text{ °C}$ (±5 mV for $I_{PM} \leq 100\text{ A}$ )                 |
| Linearity error                             | $\varepsilon_L$ | %     |                                                 | ±0.5    |         | % of full scale, method 2                                                                             |
| Average temperature coefficient of $V_{OE}$ | $TCV_{OEAV}$    | mV/°K | -0.1                                            | ±0.04   | 0.1     | @ $U_C = 5\text{ V}$                                                                                  |
| Average temperature coefficient of $G$      | $TCG_{AV}$      | %/°K  | -0.03                                           | ±0.01   | 0.03    |                                                                                                       |
| Step response time @ 70 %                   | $t_r$           | ms    |                                                 |         | 10      |                                                                                                       |
| Frequency bandwidth                         | $BW$            | Hz    |                                                 | 1100    |         | @ -3 dB, adjustable from 70 Hz to 2228 Hz                                                             |
| Peak-to-peak noise voltage                  | $V_{no\ pp}$    | mV    |                                                 |         | 10      | DC to 1 MHz; 20 mV for $I_{PM} \leq 100\text{ A}$                                                     |
| Output RMS noise voltage                    | $V_{no}$        | mV    |                                                 |         | 1.5     | DC to 1 MHz; 3 mV for $I_{PM} \leq 100\text{ A}$                                                      |
| Start up time                               | $t_{start}$     | ms    |                                                 |         | 1       |                                                                                                       |
| Setting time after overload                 | $t_s$           | ms    |                                                 |         | 10      |                                                                                                       |

**HSNBV 100-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |         | Conditions                                                               |
|---------------------------------------------|----------|------|---------------|---------|---------|--------------------------------------------------------------------------|
|                                             |          |      | Min           | Typical | Max     |                                                                          |
| Electrical Data                             |          |      |               |         |         |                                                                          |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −100          |         | 100     |                                                                          |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −100          |         | 100     | As option                                                                |
| Sensitivity                                 | $G$      | mV/A |               | 20      |         | @ $T_A = 25\text{ °C}$                                                   |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |         | @ $U_C = 5\text{ V DC}$                                                  |
| Current Consumption                         | $I_C$    | mA   |               | 9 (18)  | 12 (24) | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$ (..) value for dual output |

**HSNBV 200-X00**

| Parameter                                   | Symbol     | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|------------|------|---------------|---------|-----|-------------------------|
|                                             |            |      | Min           | Typical | Max |                         |
| Electrical Data                             |            |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{P\,M}$ | A    | −200          |         | 200 |                         |
| Primary current, measuring range (output 2) | $I_{P\,M}$ | A    | −200          |         | 200 | As option               |
| Sensitivity                                 | $G$        | mV/A |               | 10      |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$      | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 300-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −300          |         | 300 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −300          |         | 300 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 6.67    |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 400-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −400          |         | 400 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −400          |         | 400 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 5       |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 500-X00**

| Parameter                                   | Symbol     | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|------------|------|---------------|---------|-----|-------------------------|
|                                             |            |      | Min           | Typical | Max |                         |
| Electrical Data                             |            |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{P\ M}$ | A    | −500          |         | 500 |                         |
| Primary current, measuring range (output 2) | $I_{P\ M}$ | A    | −500          |         | 500 | As option               |
| Sensitivity                                 | $G$        | mV/A |               | 4       |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$      | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 600-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −600          |         | 600 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −600          |         | 600 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 3.33    |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V'_O$   | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 700-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −700          |         | 700 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −700          |         | 700 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 2.86    |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 800-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −800          |         | 800 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −800          |         | 800 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 2.5     |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV 900-X00**

| Parameter                                   | Symbol   | Unit | Specification |         |     | Conditions              |
|---------------------------------------------|----------|------|---------------|---------|-----|-------------------------|
|                                             |          |      | Min           | Typical | Max |                         |
| Electrical Data                             |          |      |               |         |     |                         |
| Primary current, measuring range (output 1) | $I_{PM}$ | A    | −900          |         | 900 |                         |
| Primary current, measuring range (output 2) | $I_{PM}$ | A    | −900          |         | 900 | As option               |
| Sensitivity                                 | $G$      | mV/A |               | 2.22    |     | @ $T_A = 25\text{ °C}$  |
| Offset voltage                              | $V_O$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$ |

**HSNBV-D02**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | 0             |         | 120 |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 33.33   |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 0.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | -200          |         | 200 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 10      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D03**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | −700          |         | 700 |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 2.86    |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | −200          |         | 200 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 10      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D04**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | −350          |         | 350 |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 5.71    |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | −100          |         | 100 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 20      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D05**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | -50           |         | 50  |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 40      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | -400          |         | 400 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 5       |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D06**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                    |
|---------------------------------------------|-----------|------|---------------|---------|-----|-----------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                               |
| Electrical Data                             |           |      |               |         |     |                                               |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | −50           |         | 50  |                                               |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 40      |     | @ $T_A = 25\text{ °C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                       |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | −300          |         | 300 |                                               |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 6.67    |     | @ $T_A = 25\text{ °C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                       |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D07**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | -80           |         | 80  |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 25      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | -500          |         | 400 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 4.44    |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.72    |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D08**

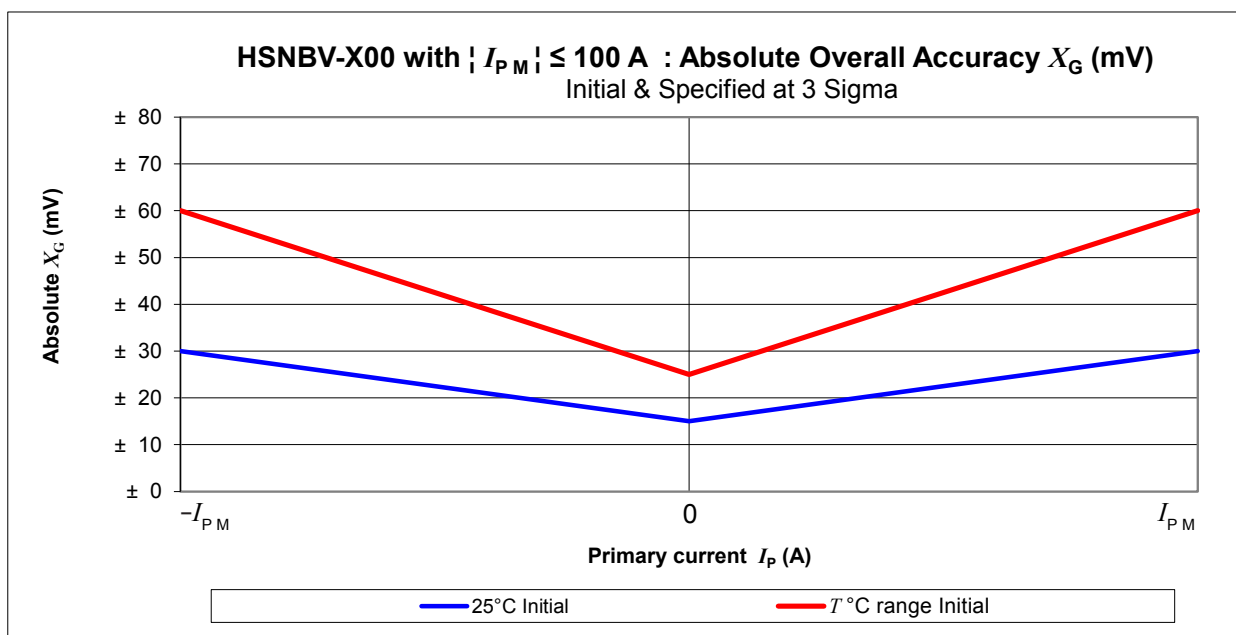
| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                    |
|---------------------------------------------|-----------|------|---------------|---------|-----|-----------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                               |
| Electrical Data                             |           |      |               |         |     |                                               |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | −50           |         | 50  |                                               |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 40      |     | @ $T_A = 25\text{ °C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                       |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | −600          |         | 600 |                                               |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 3.33    |     | @ $T_A = 25\text{ °C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                       |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ °C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D09**

| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | -50           |         | 50  |                                                             |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 40      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | -500          |         | 500 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 4       |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |

**HSNBV-D10**

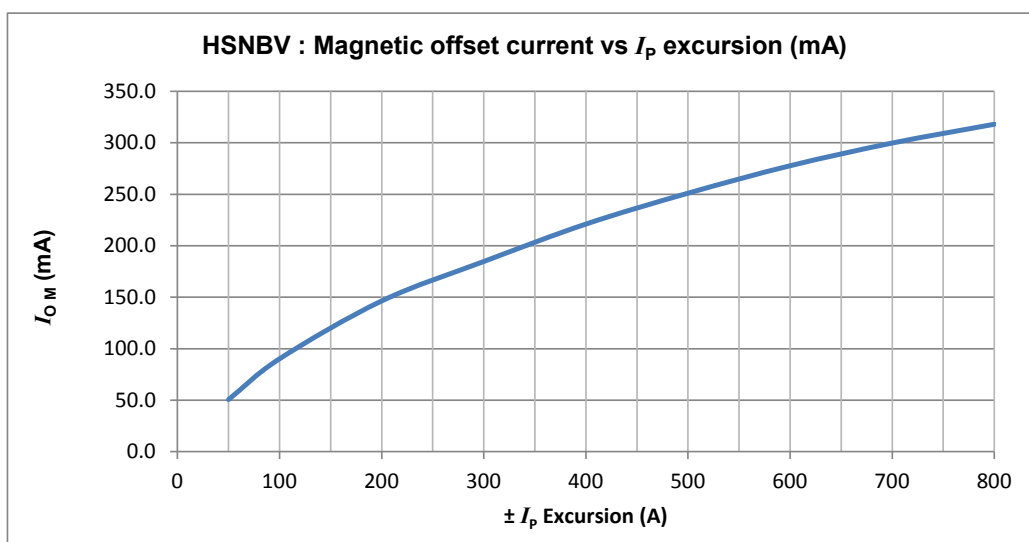
| Parameter                                   | Symbol    | Unit | Specification |         |     | Conditions                                                  |
|---------------------------------------------|-----------|------|---------------|---------|-----|-------------------------------------------------------------|
|                                             |           |      | Min           | Typical | Max |                                                             |
| Electrical Data                             |           |      |               |         |     |                                                             |
| Primary current, measuring range (output 1) | $I_{PM}1$ | A    | -600          |         | 600 | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Sensitivity (output 1)                      | $G1$      | mV/A |               | 3.33    |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 1)                   | $V_O1$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Primary current, measuring range (output 2) | $I_{PM}2$ | A    | -200          |         | 200 |                                                             |
| Sensitivity (output 2)                      | $G2$      | mV/A |               | 10      |     | @ $T_A = 25\text{ }^{\circ}\text{C}$                        |
| Offset voltage (output 2)                   | $V_O2$    | V    |               | 2.5     |     | @ $U_C = 5\text{ V DC}$                                     |
| Current Consumption                         | $I_C$     | mA   |               | 16      | 22  | @ $T_A = 25\text{ }^{\circ}\text{C}$ , @ $U_C = 5\text{ V}$ |



#### Overall Accuracy (mV) for $I_{PM} \leq 100$ A

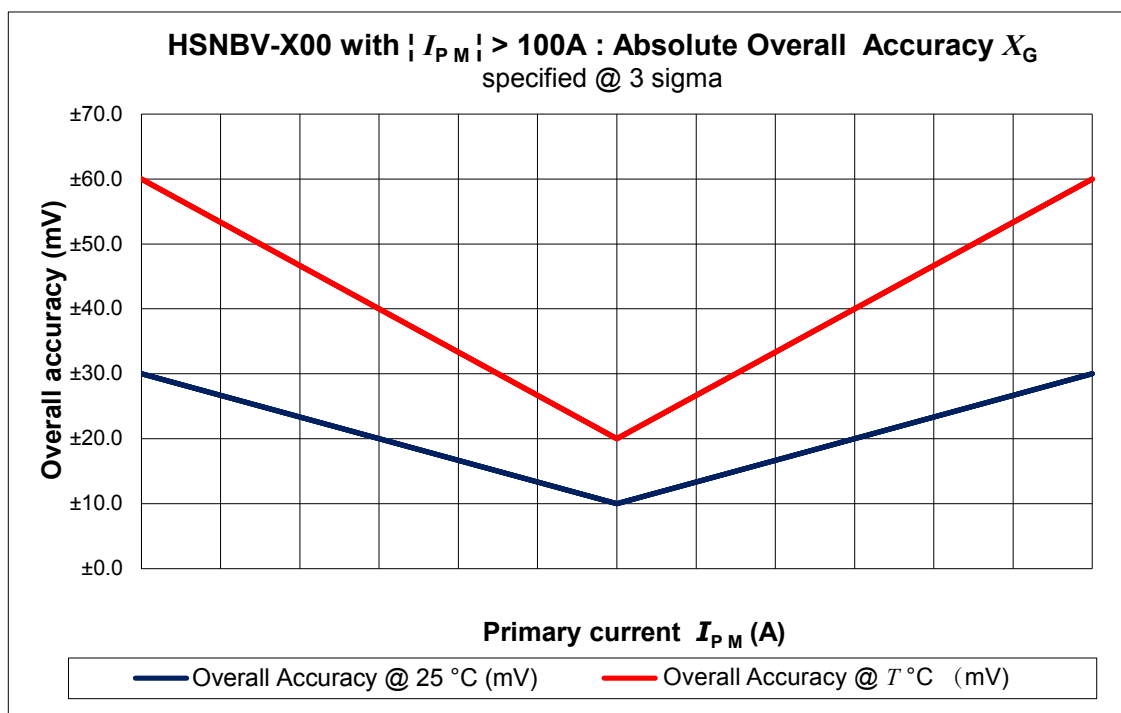
| $I_p$ (A) | 25 °C initial | T °C range initial | 25 °C after reliability | T °C after reliability |
|-----------|---------------|--------------------|-------------------------|------------------------|
| $-I_{PM}$ | ±30           | ±60                | ±45                     | ±60                    |
| 0         | ±15           | ±25                | ±15                     | ±25                    |
| $I_{PM}$  | ±30           | ±60                | ±45                     | ±60                    |

#### Magnetic offset current $I_{OM}$ vs $I_p$ excursion



#### NOTE:

For HSNBV-Dxx and  $I_{PM}$  Low range  $\leq 100$  A, the global offset ( $X_G$ ) of Low range could slightly exceed the warranty value ( $\pm 15$  mV). This is due to the magnetic offset generated by the high range current which is also seen by the Low range channel (see the above chart).

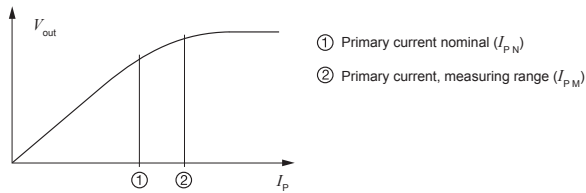


#### Overall Accuracy (mV) for $I_{PM} > 100 A$

| $I_p$ (A) | 25 °C initial | $T$ °C range initial | 25 °C after reliability | $T$ °C after reliability |
|-----------|---------------|----------------------|-------------------------|--------------------------|
| $-I_{PM}$ | ±30           | ±60                  | ±45                     | ±60                      |
| 0         | ±10           | ±20                  | ±10                     | ±20                      |
| $I_{PM}$  | ±30           | ±60                  | ±45                     | ±60                      |

## PERFORMANCES PARAMETERS DEFINITIONS

### Primary current definition:



### Definition of typical, minimum and maximum values:

Minimum and maximum values for specified limiting and safety conditions have to be understood as such as values shown in "typical" graphs. On the other hand, measured values are part of a statistical distribution that can be specified by an interval with upper and lower limits and a probability for measured values to lie within this interval. Unless otherwise stated (e.g. "100 % tested"), the LEM definition for such intervals designated with "min" and "max" is that the probability for values of samples to lie in this interval is 99.73 %. For a normal (Gaussian) distribution, this corresponds to an interval between  $-3$  sigma and  $+3$  sigma. If "typical" values are not obviously mean or average values, those values are defined to delimit intervals with a probability of 68.27 %, corresponding to an interval between  $-\text{sigma}$  and  $+\text{sigma}$  for a normal distribution. Typical, minimum and maximum values are determined during the initial characterization of a product.

### Output noise voltage:

The output voltage noise is the result of the noise floor of the Hall elements and the linear amplifier.

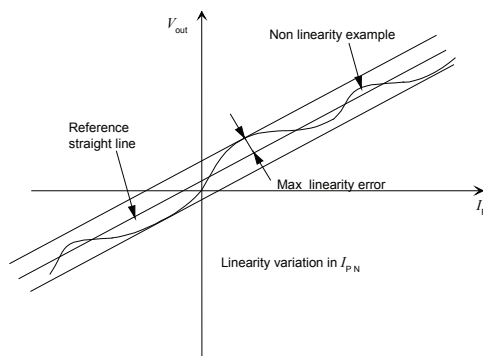
### Magnetic offset:

The magnetic offset is the consequence of an any current on the primary side. It's defined after a stated excursion of primary current.

### Linearity:

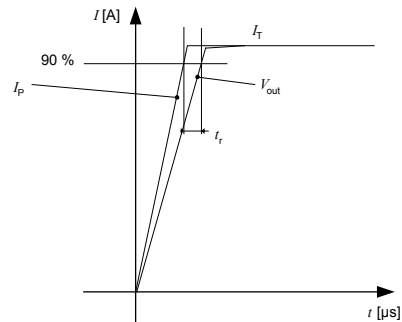
The maximum positive or negative discrepancy with a reference straight line  $V_{out} = f(I_p)$ .

Unit: linearity (%) expressed with full scale of  $I_{pN}$ .



### Response time (delay time) $t_r$ :

The time between the primary current signal ( $I_{pN}$ ) and the output signal reach at 90 % of its final value.



### Sensitivity:

The transducer's sensitivity  $G$  is the slope of the straight line

$V_{out} = f(I_p)$ , it must establish the relation:

$$V_{out}(I_p) = U_C/5 (G \times I_p + V_O)$$

### Offset with temperature:

The error of the offset in the operating temperature is the variation of the offset in the temperature considered with the initial offset at 25 °C.

The offset variation  $I_{OT}$  is a maximum variation the offset in the temperature range:

$$I_{OT} = I_{OE \max} - I_{OE \min}$$

The offset drift  $TCI_{OEAV}$  is the  $I_{OT}$  value divided by the temperature range.

### Sensitivity with temperature:

The error of the sensitivity in the operating temperature is the relative variation of sensitivity with the temperature considered with the initial offset at 25 °C.

The sensitivity variation  $G_T$  is the maximum variation (in ppm or %) of the sensitivity in the temperature range:

$$G_T = (\text{Sensitivity max} - \text{Sensitivity min}) / \text{Sensitivity at } 25^\circ\text{C}$$

The sensitivity drift  $TCG_{AV}$  is the  $G_T$  value divided by the temperature range. Deeper and detailed info available is our LEM technical sales offices ([www.lem.com](http://www.lem.com)).

### Offset voltage @ $I_p = 0$ A:

The offset voltage is the output voltage when the primary current is zero. The ideal value of  $V_O$  is  $U_C/2$ . So, the difference of  $V_O - U_C/2$  is called the total offset voltage error. This offset error can be attributed to the electrical offset (due to the resolution of the ASIC quiescent voltage trimming), the magnetic offset, the thermal drift and the thermal hysteresis. Deeper and detailed info available is our LEM technical sales offices ([www.lem.com](http://www.lem.com)).

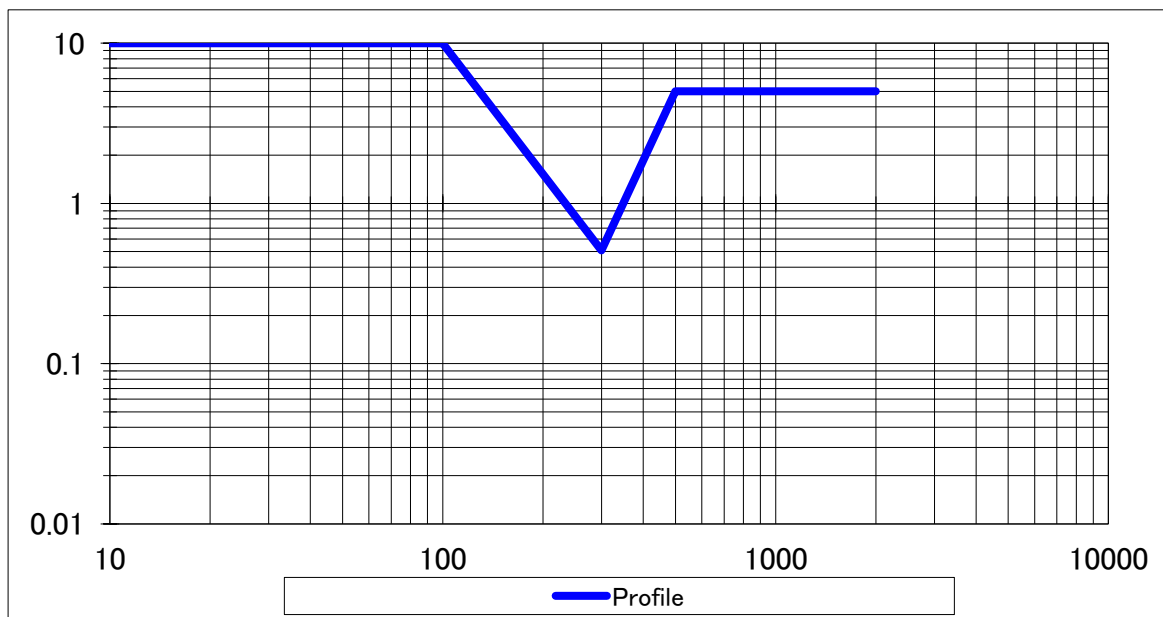
### Environmental test specifications:

Refer to LEM GROUP test plan laboratory CO.11.11.515.0 with "Tracking\_Test Plan\_Auto" sheet.

**Environmental test specifications:**

Refer to LEM GROUP test plan laboratory CO.11.11.515.0 with "Tracking\_Test Plan\_Auto" sheet.

| Name                                                       | Standard                        | Conditions                                                                                                                                                                                                                                                                       |
|------------------------------------------------------------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ELECTRICAL TESTS</b>                                    |                                 |                                                                                                                                                                                                                                                                                  |
| RMS voltage for AC insulation test                         | IEC 60664 part 1                | 2.5 kV AC / 1 min / 50 Hz ( $I < 0.1$ mA)                                                                                                                                                                                                                                        |
| Insulation resistance test                                 | ISO 16750-2 (2010)              | 500 V DC, time = 60 s<br>$R_{INS} > = 500$ M $\Omega$ Minimum                                                                                                                                                                                                                    |
| <b>ENVIRONMENTAL TESTS</b>                                 |                                 |                                                                                                                                                                                                                                                                                  |
| High $T$ °C, High Humidity, Electrical connection          | JESD 22-A101 (03/2009)          | 1000 h +85 °C / 85 % RH<br>$U_C = 5$ V DC, $I_p = 0$ A                                                                                                                                                                                                                           |
| Thermal Cycle Test (Simplified profile)                    | IEC 60068-2-14, Test Nb         | $T$ min -40°C , $T$ max = +125 °C<br>1 cycle = 480 min, 30 cycles<br>$U_C = 5$ V ( $\equiv$ connected); $I_p = 0$ A                                                                                                                                                              |
| Thermal Shock                                              | ISO-16750-4 § 5.3.2 (04/2010)   | 1000 cycles<br>30 min ""-40 °C"" // 30 min ""+85 °C""<br>$U_C$ not connected, $I_p = 0$ A                                                                                                                                                                                        |
| High $T$ °C Storage                                        | IEC 60068-2-2, Bd (07/2007)     | 125 °C for 1000 h<br>$U_C$ not connected, $I_p = 0$ A                                                                                                                                                                                                                            |
| Low $T$ °C Storage                                         | IEC 60068-2-1, Ad (03/2007)     | -40 °C for 240 h<br>$U_C$ not connected, $I_p = 0$ A                                                                                                                                                                                                                             |
| Mechanical Shock                                           | ISO-16750-3 § 4.2.2 (12/2012)   | 50 g / 6 ms Half Sine @ 25 °C<br>10 shocks of each direction<br>$U_C$ not connected, $I_p = 0$ A                                                                                                                                                                                 |
| Random vibration test in $T$ °C profile                    | IEC 60068-2-27, (02/2008)       | 22 h for each axe; Tests condition : see sheet "vibration profile". $U_C = 5$ V only during Op. mode 3.2 ; $I_p = 0$ A                                                                                                                                                           |
| <b>EMC TESTS ES96200 (11.2011)</b>                         |                                 |                                                                                                                                                                                                                                                                                  |
| Radiated Emission Absorber Lined Shielded Enclosure (ALSE) | CISPR25 (2008) Table9 - class 5 | F = 150 kHz to 2.5 GHz<br>Criteria A acceptance @ 5 % of 2 V                                                                                                                                                                                                                     |
| Radiated Immunity Bulk Current Injection (BCI)             | GMW3097 §3.4.1 (2015)           | Level : GMW 3097 (2015) § 3.4.1 Table 13 - Level1 (100 mA) (ISO11452-4 (2011) Annex E Table E1 Level 2)<br>F = 1 MHz to 400 MHz . Criteria A acceptance @ 5 % of 2 V                                                                                                             |
| Radiated Immunity Anechoic chamber                         | GMW3097 §3.4.2 (2015)           | Level : GMW 3097 (2015) § 3.4.2 Table 14 - Level 2 (100 V/m)<br>F = 400 MHz to 1 GHz; Level = 100 V/m (CW, AM 80%)<br>F = 0.8 GHz to 2 GHz; Level = 70 V/m (CW, PM PRR = 217 Hz<br>PD = 0.57 ms) ; F = 1 GHz to 2 GHz; Level = 70 V/m (CW)<br>Criteria A acceptance @ 5 % of 2 V |
| ESD Test                                                   | GMW3097 §3.6.3 (2015)           | Level : GMW 3097 (2015) § 3.6.3.3 Table 28<br>Contact discharges: $\pm 4$ , 6 kV; Air discharges: $\pm 8$ kV<br>$U_C =$ NO power supply ( $\equiv$ unconnected). Criteria B                                                                                                      |
| <b>MECHANICAL TESTS</b>                                    |                                 |                                                                                                                                                                                                                                                                                  |
| Free Fall (Device not packaged)                            | ISO 16750-3§ 4.3 (12/2012)      | Height = 1 m; Concrete floor<br>3 axis; 2 directions by axis; 1 sample by axis                                                                                                                                                                                                   |

**Random Vibration Profile @  $-40\text{ °C} < T < 125\text{ °C}$** 


| Hz        | PSD [(m/s²)² / Hz] |
|-----------|--------------------|
| Frequency | Profile 1          |
| 10        | 10                 |
| 100       | 10                 |
| 300       | 0.51               |
| 500       | 5                  |
| 1000      | 5                  |
| 2000      | 5                  |

Test duration: 22h (each X, Y, Z Axis)  
 RMS acceleration value:  $9.66\text{ g}_{\text{rms}}$

**Climatic Profile**

Temperatures:

- Step 1:** 60 min from  $+20\text{ °C}$  to  $-40\text{ °C}$
- Step 2:** 90 min at  $-40\text{ °C}$
- Step 3:** 150 min from  $-40\text{ °C}$  to  $+125\text{ °C}$
- Step 4:** 110 min at  $+125\text{ °C}$
- Step 5:** 70 min from  $+125\text{ °C}$  to  $+20\text{ °C}$

*Steps 1 to 5 are repeated 3 times*

**Steps 6:** 60 min at  $+20\text{ °C}$

**Recommendations for use:****Storage:**

The LEM transducers must be stored in a dry location, within the following ambient room conditions ( $< 40\text{ }^{\circ}\text{C}$  and  $< 60\text{ \% RH}$ ). The product should be stored in its original packing. Ensure during storage and transport, the units are not damaged by applying excess weight to the packaging. The transducers must not be stored more than 3 months. Maximal stackup storage of secondary container (pallet) must not exceed 2.

**Unpacking:**

When unpacking, care must be taken with cutting tools not to damage the transducer.

**Handling:**

The LEM transducers must be handled with care and not undergo any shocks or falls (fall = scrap). It is recommended to handle the transducer as long as possible inside its original packing (thermoform tray on customer's assembly station). It is forbidden to handle the transducers by their terminals. To avoid problems of ESD, it is recommended not to touch secondary terminals. Any rework operation are forbidden and will conduct part out of LEM warranty.

**Installation:**

The workshop and the people in contact with the transducers must be ESD protected. Before installing, be sure to check that the transducer corresponds to the required application. Be sure that the air gap between the housing of the transducer and the primary bar is sufficient to avoid damage in case of vibrations.

LEM does not recommend customers to make any maintenance on LEM sensors other wise, it will drive sensors directly out of warranty.

Concerning installation and re-installation, cautiously care need to be taken for taped sensors same for screwed sensors. Sensors fixed by clips must be scraped after any dismounting from the original locations.